Drivers of N_2O Production in a Vineyard Under Different Cover Crops

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INTRODUCTION

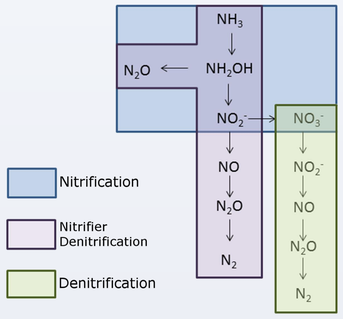

Figure 1: Primary Pathways of N_2O Production in Soils

Agricultural sources account for 70% of global N_2O emissions.[1]

OBJECTIVES

FIELD OBSERVATIONS

Question: Do different cover crops lead to different rates of N_2O emissions?

Cover crop treatments (all planted at 112 kg ha^{-1})

- Ryegrass
- Legume Mix consisting of faba bean (50%) and forage pea (50%) mix
- 'Soil Builder' mix consisting of triticale (24.7%), faba beans (44.7%), forage peas (9.7%), common vetch (14.9%), and common mustard (4.8%)
- Fallow control

Figure 2: Field Gas Sampling

Figure 3: 'Soil Builder' Mix

LAB INCUBATION

Question: What drives observed N_2O emissions on soil rewetting?

- A 1.5cm rainfall event was simulated on 15cm undisturbed soil cores taken after dry period.
- Examined relationship between N_2O and nitrate (NO_3-), ammonium (NH_4^+), and dissolved organic carbon (DOC) during rewetting event.

Figure 4: Lab Core Incubation

FIELD WORK RESULTS

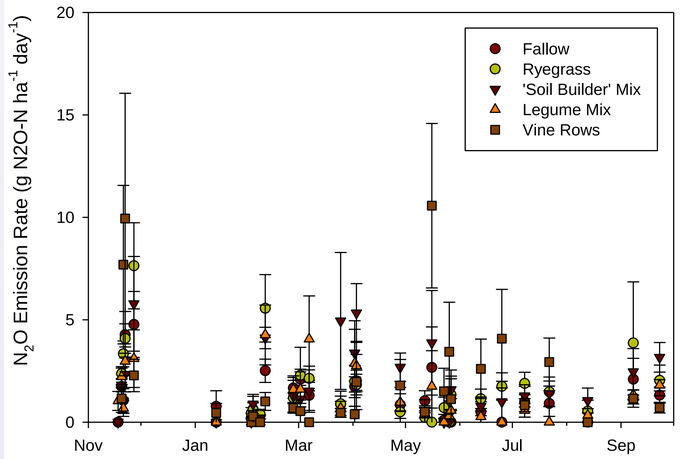

Figure 5: Field N_2O Emissions – Error bars show +/- 1 SE (n = 4). Vine rows were irrigated twice a week from 5/1/14 through 10/8/14, and were fertilized on 5/1/14 and 5/14/14, 6/1/14 ad 6/14/14 each at a rate of 3.96 kg N ha^{-1} in the form of Calcium Ammonium Nitrate.

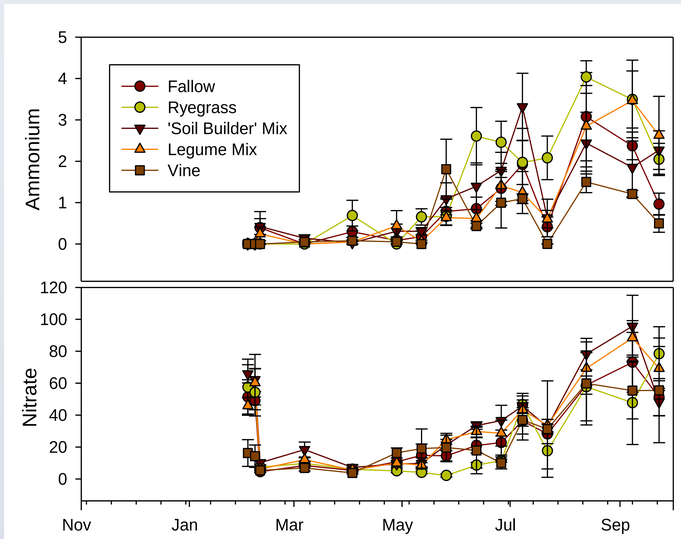

Figure 6: Inorganic N Levels – Error bars show +/- 1 SE (n = 4). All data is expressed in mg kg^{-1} oven dried soil

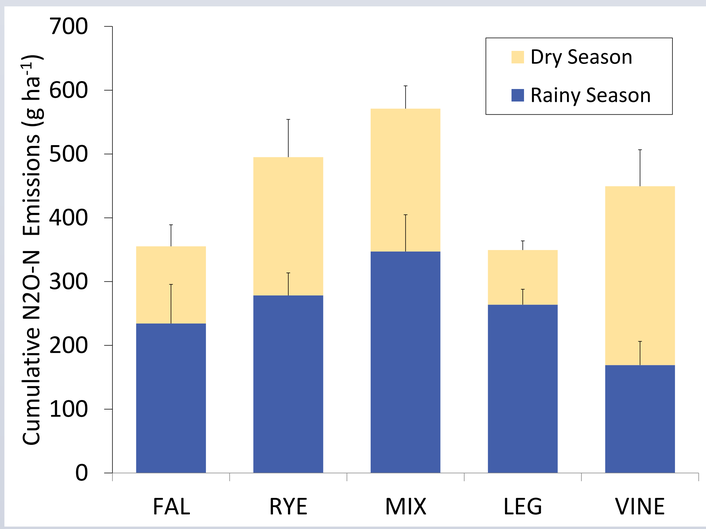

Figure 7: Cumulative N_2O Emissions and Relative Contributions from Dry and Rainy Season - The rainy season started on 11/20/2013 and lasted through 4/28/2013, the dry season continued from there through the duration of the monitoring. No differences were observed in overall emissions or seasonal emissions at the p=0.05 level. Error bars show +1 SE for the seasonal cumulative emissions.

LAB WORK RESULTS

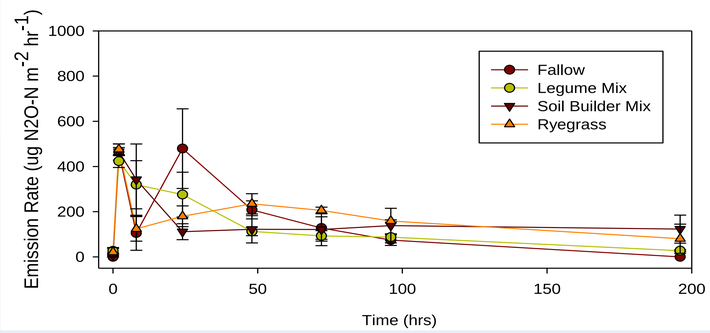

Figure 8: Incubation N_2O Emissions– Error bars shows +/- 1 SE. 16 cores (n=4) were sampled for gas emissions at 0, 2, 8, 24, 48, 72, 96, and 196 hrs after addition of 300mL of DI H_2O (equivalent to 1.5cm rainfall).

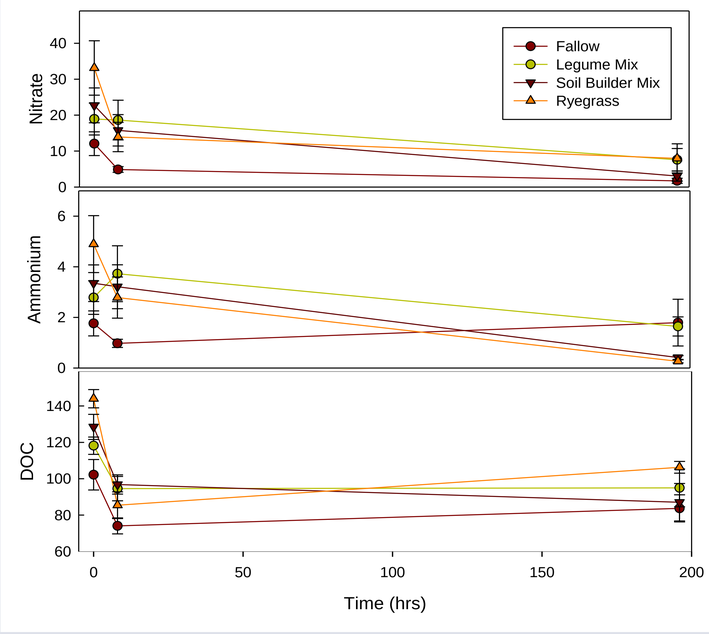

Figure 9: Incubation NO_3^-, NH_4^+, and DOC Levels - Initial field readings were taken at time of core sampling, 16 cores were destructively sampled at 8 hrs, and remaining 16 cores were sampled at 196 hrs. Error bars shows +/- 1 SE. No significant correlations were found between rate of production/consumption and N_2O emissions between 0-8 hrs (data not shown.) All data is expressed in mg kg^{-1} oven dried soil..

CONCLUSIONS

- Different cover crops do not significantly effect N_2O emissions after 1 year.
- N_2O emissions can be observed within a few hours of soil rewetting.
- Initial consumption of NO_3^- and DOC supports denitrification as key source of N_2O emission. However rate of consumption does not correlate with rate of emission between 0-8 hrs, indicating that the process is not substrate limited.
- Infiltration and redistribution of water can trigger multiple rewetting events (double peaks).

REFERENCES

1. Cole CV, Duxbury J, Freney J, Heinemeyer O, Minami K, Mosier A, Paustian K, Rosenberg N, Sampson N, Sauerbeck D, Zhao Q (1997) *Global estimates of potential mitigation of greenhouse gas emissions by agriculture*. Nutrient Cycling Agroecosystems 49:221-228

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